The porter problem in ecological economics: Solar battery recycling in rural electrification

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Outline of this presentation

1. Main topic
2. Research approach
3. Model
4. Scenario analysis

Explanation of the topic

- We propose a model for analysing an incentive compatibility problem in solid waste recycling.

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- We sketch a case study in Nepal, where rural electrification through solar home systems leads to the dumping of used batteries.

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- We sketch a case study in Nepal, where rural electrification through solar home systems leads to the dumping of used batteries.
- Main idea: Rethink policies that facilitate the introduction of aggressive solid waste in markets with an imperfect physical and institutional infrastructure.

Research approach

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Research approach

- We come up with a number of necessary conditions for an incentive-compatible contract that encourages people to hand in dead batteries.
- We sketch the reality content of the model by means of a case study about solar home systems (SHSs) in Humla, Nepal.
- Since at present no battery recycling system exists in Nepal, our analysis is based on three scenarios.
- In each scenario, NGOs may help to monitor or even maintain SHSs, or facilitate recycling.

Case background

Our case is located in Humla, a remote and poor district.

- Example of community.

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- Properly installed SHSs.

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- Battery abuse → Short lifespan.

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Case background

An NGO may not only monitor where batteries are located, but also assist with installation, training, and maintenance.

- Example of properly installed SHSs.

Case background

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- Proper battery installation $\rightarrow$ Longer lifespan.

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Model (1)

We first assume symmetric information, equal environmental impact. Principal minimises expenditures:

$$\min_{\{(\overline{p},q);(\underline{p},q)\}} \quad \Theta(q) - \left(\overline{p}\overline{\lambda} + \underline{p}\underline{\lambda}\right) q \tag{1}$$

subject to the agent's participation constraints:

$$\underline{p} - \underline{C}(q,\underline{\lambda}) \geq 0, \tag{a}$$

$$\underline{p} - \overline{C}(q,\underline{\lambda}) \geq 0, \tag{b}$$

$$\overline{p} - \underline{C}(q,\overline{\lambda}) \geq 0, \tag{c}$$

$$\overline{p} - \overline{C}(q,\overline{\lambda}) \geq 0, \tag{d}$$

and the incentive compatibility constraints:

$$\overline{p} - \overline{C}(q,\overline{\lambda}) \geq \underline{p} - \overline{C}(q,\underline{\lambda}), \tag{e}$$

$$\overline{p} - \overline{C}(q,\overline{\lambda}) \geq \overline{p} - \underline{C}(q,\overline{\lambda}), \tag{f}$$

Model (2)

- We then gradually introduce asymmetric information, and allow the solid waste to have a different environmental impact (e.g., remote areas larger environmental impact than areas nearby collection or recycling facility).
- Track records of the whereabouts of the solar PV batteries are of course crucial. Battery monitoring programmes are often lacking, particularly in remote areas (where ecosystems are often most delicate).
- Yet, even under symmetric information on battery conditions, recycling may not take place due to budget constraints of the principal.

Scenario analysis

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For each scenario, we analyse its 'reality content', as well as our expectations about the likely environmental impact.

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Scenario analysis

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1. Laissez faire: Unpredictable, huge risk of environmental damage.
2. NGO monitors: Good basis for setting up recycling programme.
3. NGO monitors & collects: Fairly predictable outcome, reduced environmental risk.

For each scenario, we analyse its ‘reality content’, as well as our expectations about the likely environmental impact.

Summary

- In this paper, we have expressed our concern about policies that facilitate the introduction of aggressive toxic solid waste into delicate ecosystems.
- We propose a model that clarifies the incentive (in)compatibility of the various contracts.
- Given a case study analysis, we propose how an incentive compatible collection & recycling programme may look like.